



PATENT  
0104-0354P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicants: William HOLM et al. Conf.: 7653  
Serial No.: 09/901,592 Art Unit: 1762  
Filed: July 11, 2001 Examiner: Fuller, Eric B.  
For: METHOD AND APPARATUS FOR APPLYING  
VISCOUS MEDIUM ONTO A SUBSTRATE

**DECLARATION UNDER 37 C.F.R. §1.131**

Assistant Commissioner for Patents  
Washington, DC 20231

Sir:

I, Thomas Skagersten, residing at Kungsholms Strand 169, SE-112 48, Stockholm, Sweden do declare and say as follows:

1. I am a citizen and a qualified patent attorney under the laws of Sweden, and I helped to draft Swedish Application No. 0002619-5, which was filed on July 11, 2000.

2. I understand that the Examiner in charge of the above-identified application has made a rejection under 35 U.S.C. § 102(e) as being anticipated by Sano, U.S. Patent No. 6,264,097 (hereinafter "the Sano Patent").

3. The Sano Patent issued on July 24, 2001, which is after the U.S. filing date of the present application of July 11, 2001. Therefore, the Examiner is relying on the filing date of June 19, 2000 of Sano as the reference date of Sano (35 U.S.C. § 102(e) date). Accordingly, the effective date of the Sano reference is June 19, 2000.

4. A verified translation of the Swedish priority application of the present application, i.e. Swedish Application No. 0002619-5, is not necessary to perfect the claim to foreign priority of the present application, because the Swedish priority application was filed in the English language on July 11, 2000. A certified copy of the Swedish priority application was submitted to the U.S. Patent Office on September 19, 2001. Therefore, the effective filing date of the present application is July 11, 2000

5. The present invention was conceived **prior to June 19, 2000** and the present invention was constructively reduced to practice on July 11, 2000 by diligently filing Swedish Application No. 0002619-5 on July 11, 2000. As evidence of prior invention, the following facts and documents are provided:

(A). The idea of Add-on jetting was presented to me in a meeting **prior to June 19, 2000**.

(B). A diagram illustrating Add-on jetting onto a screen-printed substrate was provided by the inventor, Dr. William Holm **prior to June 19, 2000**.

(C). An order for drafting and filing a patent application was received by me **prior to June 19, 2000**.

(D). A first claim draft was provided **prior to June 19, 2000**.

(E). An application draft was then provided to the inventor, Dr. William Holm, **prior to June 19, 2000**. A copy of the application draft is attached to the present Declaration. It is believed that the application draft fully supports the claims of the present application.

Furthermore, on June 22 and on June 29, 2000 I went to the client site for the day and, on all information and belief, I worked on/discussed the application with the inventor.

A final application draft was then provided to the inventor on July 5, 2000, which was discussed in a meeting at the client site on July 6, 2000.

(F). The Swedish Application was then filed on July 11, 2000.

(G) In view of the above, the Sano Patent is not available as a reference against the present application.

6. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United

Application Serial No. 09/901,592  
Attorney Docket No. 0104-0354P

States Code and such willful false statements may jeopardize the  
validity of the application or any patent issuing thereon.

20/2/2006  
Date

By Thomas Skagersten  
Thomas Skagersten

Enclosure: First Draft Specification

ADD ON JETTING**Beskrivningsförslag 1**  
**000418**Technical field of the invention

The present invention generally relates to the field of providing substrates with viscous medium. More specifically, the invention relates to a method of applying a viscous medium on a substrate, said method comprising the step of screen printing predetermined amounts of the viscous medium on predetermined positions on the substrate; an apparatus for application of a viscous medium onto a substrate, said apparatus comprising screen printing means for screen printing predetermined amounts of the viscous medium on predetermined positions on the substrate; and a device for application of additional viscous medium onto a screen printed substrate.

**Gunnar:**

15 **Ska vi ha med användningskraven här i ingressen?**

Background of the invention

The most common method of applying viscous medium, such as solder paste, to a substrate, such as a PCB, in electronics production is by using screen printing. The vast majority of viscous medium deposits can be applied by this method. However, in specific circumstances there is a need for different viscous mediums at different locations on the substrate. This poses a problem, since it is not possible to add viscous medium, after an initial application of viscous medium, by performing an extra screen printing procedure. Further, it is sometimes desired to produce patterns of viscous medium that are very difficult to achieve through screen printing, such as the pattern of an unfilled circle. It can also be desired that the applied viscous medium presents different heights at different positions on the substrate in order to accommodate components having different lead lengths.

A solution to the latter problem that has been suggested in the art is to use so called stepped stencils for the screen printing. However, these stencils present a number of drawbacks that have prevented widespread use of this solution. Also, the application of very small dots of viscous medium is not possible to obtain through screen printing, since the...

**Ja, William...varför är inte det möjligt?**

According to the state of the art, some of the above stated problems are solved by using a conventional dispensing equipment. By using a conventional dispenser it is possible to add viscous medium following an initial screen printing of the substrate, for instance for producing said patterns of viscous medium that are not easily achieved through screen printing. With a conventional dispenser it can also be possible to apply viscous medium having different height at different locations on the board. However, the conventional dispensers have a number of disadvantages. First, the process of conventional dispensing of viscous medium is relatively slow, the application of large amounts of viscous medium through conventional dispensing should be avoided. Therefore, an initial application of viscous medium can be applied through screen printing, followed by conventional dispensing of additional viscous medium. Even then, the amount that is applied through conventional dispensing should be kept at a minimum.

Further, a problem arises if additional viscous medium is applied through convention dispensing at a location where viscous medium has already been applied, as is the case when extra viscous medium is required to increase the height of the viscous medium at a specific location that has already been provided with some viscous medium through screen printing. Then, the needle of the dispensing head will get smeared by the viscous medium already present at the location on the substrate, if an attempt is made to add extra viscous medium by using a

conventional dispenser. This is due to the fact that during dispensing the needle is lowered against the board to a position where the dispensed dot is simultaneously in contact with both the needle and the board. The head is then raised such that the dot loses contact with the needle, leaving the dot on the board. Therefore, the addition of viscous medium is only possible at empty dot sites, i.e. at positions where no viscous medium has been applied.

#### Summary of the invention

Thus, an object of the present invention is to provide a solution to the above stated problems in relation to the application of additional viscous medium to a substrate that already has been subject to initial application of viscous medium through screen printing.

This and other objects are achieved according to the present invention by providing a method, an apparatus, and a device having the features defined in the independent claims. Preferred embodiments are defined in the dependent claims.

According to a first aspect of the invention, there is provided a method of applying viscous medium on a substrate, comprising the steps of screen printing predetermined amounts of the viscous medium on predetermined positions on the substrate, and add-on jetting of predetermined additional amounts of viscous medium on predetermined positions on the screen printed substrate.

According to a second aspect of the invention, there is provided an apparatus for application of a viscous medium onto a substrate, comprising screen printing means for screen printing predetermined amounts of the viscous medium on predetermined positions on the substrate, and jetting means for jetting predetermined additional amounts of viscous medium on predetermined positions on the screen printed substrate.

According to a third aspect of the invention, there is provided a device for application of additional viscous medium onto a screen printed substrate, comprising jetting means for jetting said additional amounts of viscous medium on predetermined positions on the substrate.

According to a fourth aspect of the invention, there is provided use of screen printing and subsequent jetting for applying a viscous medium on a substrate.

According to a fifth aspect of the invention, there is provided use of viscous medium jetting for applying additional viscous medium on a screen printed substrate.

For the purposes of this application, it is to be noted that the term "viscous medium" should be interpreted as solder paste, flux, adhesive, conductive adhesive, or any other kind of medium used for fastening components on a substrate, or resistive paste; and that the term "substrate" should be interpreted as a printed circuit board (PCB), a substrate for ball grid arrays (BGA), chip scale packages (CSP), quad flat packages (QFP), and flip-chips or the like. It is also to be noted that the term "jetting" should be interpreted as a non-contact dispensing process that utilises a fluid jet to form and shoot droplets of a viscous medium from a jet nozzle onto a substrate, e.g. as described in the published International Application WO 99/64167, as compared to a contact dispensing process, such as "fluid wetting", which is the act of the viscous medium leaving the dispense tip, contacting and clinging to the substrate and remaining on the substrate as the dispense tip pulls away. Further, the term "add-on" refers herein to the application of additional viscous medium, i.e. not the initial application.

Thus, the present invention is based on the advantageous idea of using add-on jetting for the application of additional viscous medium onto a substrate onto which viscous medium previously has been applied through screen printing.



As is the case with conventional dispensing, jetting overcomes a number of the above stated problems relating to screen printing. First, jetting enables the application of viscous medium of a different type or sort than what has been initially applied. The use of jetting also enables the application of viscous medium in any desired pattern, which is not possible through screen printing. The application of viscous medium of varying height is also achievable through jetting. Even though these problems can be overcome through conventional dispensing, jetting is advantageous to conventional dispensing in that it is faster, more accurate, and more flexible. In fact, the use of conventional dispensing often provides a bottle neck that increases the cycle time in the overall component mounting process, as compared to the use of jetting. It has also been found that it is possible to achieve smaller dots when using jetting than when using conventional dispensing.

Further, one of the main advantages obtained by using jetting for applying additional viscous medium onto a screen printed substrate, is that it is possible to apply viscous medium at positions where viscous medium already has been applied. Thereby, it will be possible to easily increase the height of the applied viscous medium at a specific location without any danger of the nozzle of the jetting device being smeared by the viscous medium already applied on the substrate.

According to a specific embodiment of the present invention, the results of the application of viscous medium onto the substrate is inspected, errors of the application is determined based on said inspection, and at least some of said errors are corrected, wherein said correction comprises jetting of additional viscous medium onto the substrate. This means that not only the predetermined additional amounts of viscous medium is applied onto the substrate through jetting, but also any additional amount of viscous medium that is determined to be

required as a result of errors in the regular viscous medium application.

Said inspection can be performed between the screen printing and the add-on jetting of viscous medium, following the add-on jetting of viscous medium, or both. If the inspection is performed between the screen printing and the add-on jetting, the predetermined add-on jetting can be combined with the correction jetting, either by determining the positions where jetting is required and the amount, or by performing the add-on jetting and the jetting correction in sequence.

Preferably, a single jetting means performs both the add-on jetting and the jetting correction, which decreases the physical complexity of the system. Alternatively, this is performed by separate jetting means.

When the inspection is performed following the add-on jetting only, the correction can be performed in a separate machine. This decreases the cycle time for the overall viscous medium application process, but increases the line length. If a separate machine is used for the jetting correction, the inspection, evaluation and determination of errors is preferably, but not necessarily, performed in the same machine.

According to a further embodiment of the invention, the correction of applied viscous medium also comprises the removal of surplus viscous medium. Preferably, this is performed at specific locations on the substrate only, at which the inspection has revealed that too much viscous medium has been applied. This can refer to the amount of viscous medium for a given location, the height of the applied viscous medium, or that viscous medium has been applied at a position where it was not supposed to.

It should be noted that the screen printing and the subsequent jetting of viscous medium is for the purposes of this application not limited to the use of one viscous medium for both the screen printing and the jetting. Consequently, a number of different types and sorts of vis-

cous medium can be used. For instance, the screen printing is performed for a viscous medium, then add-on jetting of another viscous medium is performed. Additionally, the subsequent jetting, the add-on jetting and/or the correction jetting, can be performed in sequences with different sorts of viscous medium. Then, more than one jetting means is preferably used to avoid unwanted mixing of the different viscous medium and/or to avoid increased cycle time due to change of the viscous medium supply and possible cleaning of the jetting means.

The above mentioned and other aspects, advantages, and features of the invention will be more fully understood from the following description of exemplifying embodiments thereof.

#### Brief description of the drawings

Exemplifying embodiments of the invention will be described below with reference to the accompanying drawings, in which:

Fig 1 shows

#### Detailed description of preferred embodiments

## CLAIMS

5 M1. A method of applying a viscous medium on a substrate, comprising the steps of  
screen printing predetermined amounts of the viscous medium on predetermined positions on the substrate, and  
add-on jetting of predetermined additional amounts of viscous medium on predetermined positions on the  
10 screen printed substrate.

M2. The method according to claim M1, comprising the steps of  
inspecting the results of said screen printing and  
15 add-on jetting,  
determining errors of said screen printing and add-on jetting based on said inspection, and  
correcting at least some of said errors, wherein said correction comprises supplemental jetting of additional viscous medium onto the screen printed substrate.  
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M3. The method according to claim M1, comprising the steps of  
inspecting the results of said screen printing prior  
25 to said add-on jetting,  
determining errors of said screen printing based on said inspection,  
correcting at least some of said errors, wherein said correcting comprises supplemental jetting of additional viscous medium onto the screen printed substrate.  
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M4. The method according to claim M3, wherein said supplemental jetting is performed in connection with performing said add-on jetting.  
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M5. The method according to any one of claims M2-M4, wherein said add-on jetting and said supplemental jetting is performed by the same jetting means.

5 M6. The method according to any one of claims M2-M5, wherein said step of correcting comprises the step of, removing amounts of viscous medium from positions on the board where larger amounts of viscous medium have been applied than intended.

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**Gunnar: Ska vi ha med underkrav på olika resp. samma sorts visköst medium?**

A1. An apparatus for application of a viscous medium  
15 onto a substrate, comprising screen printing means for screen printing predetermined amounts of the viscous medium on predetermined positions on the substrate, and jetting means for jetting predetermined additional  
20 amounts of viscous medium on predetermined positions on the screen printed substrate.

A2. The apparatus according to claim A1, comprising inspection means for inspecting the results of said  
25 screen printing and jetting, processing means for determining errors of said screen printing and jetting based on said inspection, and correction means for correcting at least some of said errors, wherein said correction means comprises jetting means arranged for supplemental jetting of amounts  
30 of viscous medium onto the screen printed substrate.

A3. The apparatus according to claim A1, comprising inspection means for inspecting the results of said  
35 screen printing, processing means for determining errors of said screen printing based on said inspection, and

correction means for correcting at least some of said errors, wherein said correction means comprises jetting means arranged for supplemental jetting of amounts of viscous medium onto the screen printed substrate.

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A4. The apparatus according to claim A2 or A3, wherein the correction means comprises removing means for removing viscous medium from the screen printed substrate.

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A5. The apparatus according to any one of claims A2-A4, wherein the jetting means for jetting additional amounts of viscous medium on predetermined positions on the substrate and the supplemental jetting means is the same jetting means.

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D1. A device for application of additional viscous medium onto a screen printed substrate, comprising jetting means for jetting said additional amounts of viscous medium on predetermined positions on the substrate.

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D2. The device according to claim D1, comprising inspection means for inspecting the results of said screen printing and jetting,

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processing means for determining errors of said screen printing and jetting based on said inspection, and correction means for correcting at least some of said errors, wherein said correction means comprises jetting means arranged for supplemental jetting of amounts of viscous medium onto the screen printed substrate.

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D3. The device according to claim D1, comprising inspection means for inspecting the results of said screen printing,

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processing means for determining errors of said screen printing based on said inspection, and

correction means for correcting at least some of said errors, wherein said correction means comprises jetting means arranged for supplemental jetting of amounts of viscous medium onto the screen printed substrate.

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D4. The device according to claim D2 or D3, wherein the correction means comprises removing means for removing viscous medium from the screen printed substrate.

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D5. The device according to any one of claims D2-D4, wherein the jetting means for jetting additional amounts of viscous medium on predetermined positions on the substrate and the supplemental jetting means is the same jetting means.

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U1. Use of screen printing and subsequent jetting for applying a viscous medium on a substrate.

U2. Use of viscous medium jetting for applying additional viscous medium on a screen printed substrate.

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**ABSTRACT**